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(54) LIGHTING DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To enhance display quality in a reflection liquid crystal device by preventing the light from scattering to a display direction peculiar to a point light source of a lighting device containing the point light source.

SOLUTION: This lighting device is equipped with at least one point light source and a light guide plate having a reflector that reflects the illuminating light from the point light source to a lighted substrate. Then, the lighting device is equipped with a optical member 1 having micro prisms outputting the illuminating light to the light guide plate, where an output direction of the illuminating light and intensity distribution of the light are changed by refracting the illuminating light from the point light source according as its incident angle.

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CLAIMS

[Claim(s)]

[Claim 1] In a lighting system equipped with at least one point light source which irradiates light, and the light guide plate which has the reflective section which reflects the illumination light from said point light source in an illuminated body side The lighting system characterized by changing the direction of outgoing radiation and the optical intensity distribution of said illumination light, providing the optical member which carries out outgoing radiation to said light guide plate, and arranging said optical member between said point light sources and said light guide plates by making the illumination light from said point light source refracted according to an incident angle.

[Claim 2] Said optical member is a lighting system according to claim 1 characterized by forming the micro prism which functions as making a beam of light refracted on either optical plane of incidence or an optical outgoing radiation side.

[Claim 3] It is alpha=beta when P and effective flare half width of said point light source are set [the distance of the optical member and the point light source in which alpha and this micro prism were formed in the angle of refraction of said micro prism] to beta for the pitch between L and said two or more point light sources in said lighting system. Lighting system according to claim 2 characterized by setting up the angle of refraction of said micro prism so that it may be set to P/2=L-tanbeta.

[Claim 4] The lighting system according to claim 1 characterized by making the diffusion plate for diffusing light between said point light sources and said optical members intervene in said lighting system.

[Claim 5] The lighting system according to claim 2 characterized by providing the function to prepare minute

irregularity in the optical plane of incidence of said optical member, or one front face of the optical outgoing radiation sides, and to diffuse a beam of light in said lighting system.

[Claim 6] The lighting system according to claim 1 characterized by preparing the prism deficit section in said optical member according to arrangement and intensity distribution of the point light source in said lighting system.

[Claim 7] The lighting system characterized by forming the micro prism to which the travelling direction and the optical intensity distribution of said illumination light are transformed by providing the point light source which irradiates light, and the light guide plate which has the reflective section which reflects the illumination light from said point light source in an illuminated body side, and making the illumination light from said point light source refracted in the optical plane of incidence of said light guide plate according to an incident angle.

[Claim 8] The lighting system according to claim 7 characterized by providing the function to prepare minute irregularity in the front face of the micro prism formed in the optical plane of incidence of said light guide plate in said lighting system, and to diffuse a beam of light.

[Claim 9] The lighting system characterized by being formed in the Fresnel configuration who transforms the travelling direction and the optical intensity distribution of said illumination light in a lighting system equipped with the point light source which irradiates light, and the light guide plate which has the reflective section which reflects the illumination light from said point light source in an illuminated body side when the optical plane of incidence of said light guide plate makes the illumination light from said point light source refracted according to an incident angle.

[Claim 10] The lighting system according to claim 9 characterized by forming prism in the part in which the beam of light of the strongest brightness carries out incidence from said point light source in said lighting system by the optical plane of incidence in which said Fresnel configuration was formed.

[Claim 11] The lighting system according to claim 1 characterized by providing the guide section prepared in fields other than the measuring area in the optical plane of incidence of said light guide plate, and the fixed hole which fits into fields other than the measuring area in the optical outgoing radiation side of said optical member at said guide section in said lighting system, inserting a fixed hole in said guide section, and fixing said light guide plate to a predetermined location.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the lighting system used for a reflective mold liquid crystal display.

[0002]

[Description of the Prior Art] Generally, it has the lighting system so that a liquid crystal display can be used as it is dark in a perimeter. When it divides roughly, there are a back light mold lighting system illuminated from the background of a transparency mold liquid crystal display and a front light mold lighting system illuminated from the side front of a reflective mold liquid crystal display. Since the formation of small lightweight and a low power are called for, many reflective mold liquid crystal displays are used for a small pocket device, and the front light mold

lighting system which is the need and which can be illuminated by the way is carried in the display at it.

[0003] In the conventional front light mold lighting system, a light guide plate is prepared ahead of a liquid crystal display screen, incidence of the illumination light is carried out into a light guide plate from a longitudinal direction, and the whole screen is made bright. Therefore, to make the whole screen into homogeneity-brightness was desired, the line light source of a fluorescent lamp etc. has been arranged on the screen side face, and incidence of the illumination light was carried out.

[0004] however, the case where a fluorescent lamp is used -- the increase of the thickness of a lighting system -- stripes -- it may be unacquainted, there is a problem and it considers using the point light source of light emitting diode (LED) etc. When this point light source is used, while miniaturization and low-power-ization can be realized, since it is the point light source, there is a problem that the difference (brightness nonuniformity) of the optical reinforcement in the display screen becomes large on the outskirts of it near the light source. Therefore, two or more point light sources are arranged, or between the point light source and a light guide plate, a diffusion plate is arranged and various attempts are made with it being as making the peak of brightness ease ****.

[0005]

[Problem(s) to be Solved by the Invention] In the case of the lighting system by the point light source mentioned above, only the flare angle of the beam of light which carries out incidence of the point light source to a light guide plate in the configuration diffused with a diffusion plate only becomes large, the direction of a beam of light is not changed, and there is no change in the source of luminescence itself being luminescence from one point. therefore -- as effectiveness -- a screen – overall brightness nonuniformity is extent eased a little.

[0006] Moreover, the rib-like projection which has a reflector for reflecting in a liquid crystal display section side in a light guide plate is prepared, and it is devised so that brightness may become homogeneity. However, when this was carried out, the continuous bright line (scattered light) by echo occurred in a part for a height, straight-line-like **** appeared on the screen, and it became a problem in respect of visibility. When the diffusion plate mentioned above to this problem is used, it is extent to which **** fades and it cannot be said that it has solved in respect of visibility.

[0007] On the other hand, much cylindrical projections 82 are formed in the reflector of the light guide plate 81 as shown in drawing 18 in JP,10-188636,A, the incident light from the point light source 83 is diffused, generating of the continuous bright line is controlled, and the lighting system which realizes uniform lighting is proposed, for example. Although this technique has effectiveness at the point which controls generating of the bright line (scattered light) which is visible to straight-line-like **** Since there is no function in which diffuse the illumination light in the a large number part of the display screen, and brightness nonuniformity changes the direction of the beam of light which has only prevented becoming a line and carries out incidence like [this technique] a diffusion plate, If it sees from the whole screen, brightness is so high that it is close to the point light source, the annular breadth to which the long distance circumference becomes dark will be shown, and there will be no change in the source of luminescence itself being a point.

[0008] Then, as this invention makes the illumination light from the point light source refracted according to the incident angle to a light guide plate, it removes dispersion to the display direction of a point light source proper by changing a direction and optical intensity distribution and making it uniform just like the line light source, and it aims at offering the lighting system which raises display quality.

[0009]

[Means for Solving the Problem] In a lighting system equipped with the light guide plate which has the reflective section which reflects in an illuminated body side the illumination light from at least one point light source which irradiates light, and said point light source in order that this invention may attain the above-mentioned object By making the illumination light from said point light source refracted according to an incident angle, the direction of outgoing radiation and the optical intensity distribution of said illumination light are changed, the optical member irradiated to said light guide plate is provided, and the lighting system with which said optical member is arranged between said point light sources and said light guide plates is offered.

[0010] The micro prism which functions as said optical member making a beam of light refracted in either optical plane of incidence or an optical outgoing radiation side is formed. Moreover, it is alpha=beta when P and effective flare half width of said point light source are set [the distance of the optical member and the point light source in which alpha and this micro prism were formed in the angle of refraction of said micro prism] to beta for the pitch between L and said two or more point light sources in said lighting system. The angle of refraction of said micro prism is set up so that it may be set to P/2=L-tanbeta.

[0011] Moreover, in a lighting system equipped with the point light source which irradiates light, and the light guide plate which has the reflective section which reflects the illumination light from said point light source in an illuminated body side, the lighting system with which the micro prism to which the travelling direction and the optical intensity distribution of said illumination light are transformed is formed is offered by making the illumination light from said point light source refracted in the optical plane of incidence of said light guide plate according to an incident angle.

[0012] In the lighting system of the above configurations, the optical member by which micro prism was formed in the field on the other hand makes the illumination light which the point light source irradiated refracted according to an incident angle, and is changing and carrying out outgoing radiation of the direction of incidence. By arranging this optical member ahead of a light guide plate, the bright line (the bright line is called hereafter) which makes the incidence of the beam of light carry out in the various directions to a light guide plate, and is visible to **** of the shape of a straight line by the scattered light is prevented, and the liquid crystal display section is illuminated in homogeneity.

[0013]

[Embodiment of the Invention] Hereafter, the operation gestalt of this invention is explained to a detail with reference to a drawing. This invention is a lighting system which carries the optical member of the prism configuration (micro prism) which the light which spread from the point light source is made refracted according to an incident angle, and changes the incident angle to a light guide plate, and is a configuration which arranges ahead of the beam-of-light plane of incidence of a light guide plate, and makes the intensity distribution of the light source a flat more. The optical member concerning the 1st operation gestalt in the lighting system of this invention is shown in drawing 1 , and notional explanation is given to it. This example explains by making into an example the lighting system equipped with the two point light sources for simplification of explanation. The arrow head in drawing shows the travelling direction of each beam of light.

[0014] The optical member 1 shown in drawing 1 (a) shows the condition of having seen from above, consists of outgoing radiation side 1b in which the prism configuration in which two or more triangle poles mentioned later follow flat plane-of-incidence 1a was formed, and is formed with transparent resin, glass, etc. In this drawing, the arrow head shows the path of the beam of light used as the illumination light, and according to a design, it is variously

changed so that the prism vertical angle gamma may be mentioned later, although 90 degrees is assumed.

[0015] Moreover, distance L is left and the two point light sources 2 and 3 are arranged at intervals of the pitch P at the plane-of-incidence 1a side of the optical member 1. As shown in drawing 1 (b), the angle of refraction alpha of this optical member 1 is expressed with whenever [angular relation / of the beam of light which carried out incidence vertically, and the beam of light which carried out outgoing radiation].

[0016] The travelling direction of the illumination light (beam of light) and modification of optical intensity distribution in this optical member 1 are explained. For example, if effective breadth half width of the beam of light irradiated from the point light source 2 is set to beta and it is the beam of light 10 of the direction, the beam of light 10 will be refracted, respectively by plane-of-incidence 1a of the optical member 1, and outgoing radiation side 1b, and it will set up the angle of refraction alpha of the optical member 1 so that outgoing radiation may be changed and carried out in the about Z directions. This Z direction shall be a vertical direction to the plane of incidence of the light guide plate which is not illustrated. That is, the prism vertical angle gamma is set up so that it may become alpha=beta. A beam of light 11 is the same as a beam of light 10. On the other hand, among the beams of light which carried out outgoing radiation in the about Z directions from the light source 2, since it returns to a light source 2 side again after carrying out total reflection of the beam of light 13 by the outgoing radiation side 1b side, incidence of it is not carried out to a light guide plate. However, it also has a flat field in part microscopically, and total reflection of the beam of light 14 which is decided by fabrication precision and which carried out incidence to the field is not carried out, but it is penetrated near prism top-most vertices, and goes to a light guide plate to it.

[0017] therefore, a line with the width of face over the beams of light 10, 11, and 14 which will progress to the same Z direction if it sees from a light guide plate side -- it will act as if it was carrying out outgoing radiation as a beam of light. Similarly, although the directions of radiation differ, outgoing radiation is carried out as illumination light in which the beam of light 17 irradiated from beams of light 15 and 16 and the next point light source 3 also had the width of face over a beam of light 17 from the beam of light 15.

[0018] Moreover, the spacing P of the point light sources 2 and 3 is P/2=L-tanbeta that what is necessary is just to determine that a beam of light 11 and a beam of light 18 will lap mostly when effective breadth half width is set to beta. -- (1)

What is necessary is just to make it become. What is necessary is just to set up using the above-mentioned formula (1) when taking the still larger effective breadth half width beta of the light source, for example, so that beams of light 17 and 19 may lap mostly in respect of the outgoing radiation of the optical member 1. In addition, the optical member 1 can give refractive-index distribution, and can also acquire effectiveness equivalent to the refraction effectiveness by prism.

[0019] The example of a configuration of the lighting system which mounted the optical member of this operation gestalt in the light guide plate is shown in drawing 2 , and it explains to it. Here, drawing 2 (a) shows the configuration seen from the top, and drawing 2 (b) shows the cross-section configuration in segment A-A of drawing 2 (a). Moreover, the arrow head in drawing shows the travelling direction of each beam of light. This lighting system consists of horseshoe-shaped cases 5 which arrange the optical member 1 used as the point light source 4 which contained three light emitting diodes (LED) 4a, 4b, and 4c and these point light sources 4, for example, has arranged on a straight line, and was mentioned above ahead [those / point light source 4]. The number of these point light sources 4 is the number of the arbitration in consideration of the brightness value demanded and power consumption,

is driven by the actuation circuit which is not illustrated through electrical installation, and emits light. This case 5 functions also as a reflecting plate for carrying out incidence of the illumination light with the flare of the point light source 4 to a light guide plate 6 efficiently, and the rate member of a light reflex which consists of powder, such as aluminum or white Teflon (trademark), a barium sulfate, and a magnesium oxide, etc. is prepared on that inner surface. Moreover, these rate members of a light reflex may be formed in the shape of a sheet, and may be attached in case 5 wall.

[0020] The ingredient of a light guide plate 6 consists of an acrylic, a polycarbonate, or an ingredient of a polyolefine system, and has the value before and behind a refractive index 1.5. The beam of light which has an incident angle beyond a critical angle in a light guide plate 6 among the beams of light by which incidence was carried out spreads the inside of a light guide plate, carrying out total reflection of flat part 6a and its field 6b which counters. Said critical angle is searched for by sin (1/1.5) from the refractive index of an ingredient, and becomes about 42 degrees. The image displayed with liquid crystal is observed by reflecting the part towards the liquid crystal display section 7 by minute reflector 6c, and reflecting again in the observer side B the beam of light with the incident angle beyond the critical angle which spreads the inside of a light guide plate according to the reflection factor of liquid crystal.

[0021] The illumination light which LED which is the point light source when the lighting system of this operation gestalt uses the optical member by which micro prism was formed in the field on the other hand irradiated from the above thing can be made refracted according to an incident angle, the direction of incidence to the light guide plate of the illumination light can be changed, the bright line by the scattered light can be prevented, and the liquid crystal display section can be illuminated in homogeneity.

[0022] Next, the lighting system concerning the 2nd operation gestalt is explained. An example of the optical intensity distribution by the optical member 1 of the 1st operation gestalt mentioned above is shown in drawing 3 . The optical intensity distribution at the time of luminescence of LED4 which is the point light source have the description with which optical reinforcement falls as the transverse plane of the source of luminescence serves as highest peak and goes on the outskirts, so that it may illustrate. On the other hand, the optical intensity distribution (continuous line m) of the illumination light which penetrated the optical member 1 are made as for two peaks to a part for the both side parts which separated a few from the transverse plane by the side of luminescence to the perimeter side compared with the optical intensity distribution of LED4, and the transverse plane has become the distribution to which reinforcement became weak. Since the amount penetrated rather than a beam of light with a surrounding include angle since there is a beam of light 13 which is reflected by the prism of the optical member 1 and returns in the illumination light irradiated from the transverse plane of the point light source as shown in drawing 1 decreases, this is generated.

[0023] So, with this operation gestalt, the diffusion plate 8 is arranged between the point light sources 4 and the optical members 1 in the 1st operation gestalt mentioned above, and flattening of the optical intensity distribution which penetrated the optical part 1 is in drawing. Here, drawing 4 (a) shows the configuration seen from the top, and drawing 4 (b) shows the cross-section configuration in segment C-C of drawing 4 (a). Since the beam of light of various outgoing radiation angles from the almost same location will carry out incidence to the optical member 1 and outgoing radiation be carry out in the various include angles direction like [in view of a light guide plate 6 side] beams of light 20 and 21 as by make the illumination light penetrate show this diffusion plate 8 to drawing 5 , it be spread in the various directions from each point , become like the optical reinforcement of the illumination light show

by the dotted line n of drawing 3 , and can approach by line lighting or the area light .

[0024] Next, the 3rd operation gestalt is explained.

[0025] Although flattening of optical intensity distribution was attained with the operation gestalt mentioned above using the diffusion plate, this operation gestalt is an example which improves an optical member and realizes flattening of optical intensity distribution. The optical member of this operation gestalt has prepared the prism deficit section to which transparency of the illumination light of a transverse-plane part which stands face to face against the point light source is made to increase.

[0026] As shown in drawing 6 (a) and (b), the prism deficit section 32 which becomes the optical member 31 from four holes in the location which stands face to face against the point light source according to intensity distribution is provided. Of course, four holes are examples, they can also prepare two or more holes from one, and they are arranged so that the arrangement may also make optical intensity distribution flattening. The pitch P between the angle of refraction alpha of the optical member mentioned above, the distance L of an optical member and the point light source, and two or more point light sources and the effective flare half width beta of the point light source each with combination When necessarily not becoming a linear light source and an EQC, this prism deficit section 32 is formed, and the reinforcement of the point light source stops nonuniformity on the strength with the beam of light of about 20 degrees from zero usually strongest flare angle, and becomes possible [changing into a flat linear light source].

[0027] Although the prism deficit section 32 which consists of four holes is formed with this operation gestalt, this configuration is arbitrary, and a function can be achieved if the area of a prism-like configuration is changed to a location.

[0028] The 1st modification of the prism deficit section of the optical member 31 mentioned above is shown in drawing 7 (a) and (b). It is the example which lost the prism formed in the outgoing radiation side side which stands face to face against the point light source as the prism deficit section in this example, and formed the flat field 33. By forming this flat field 33, effectiveness equivalent to the 3rd operation gestalt can be acquired.

[0029] The 2nd modification of the prism deficit section of the optical member 31 mentioned above is shown in drawing 8 (a) and (b). It is the example which formed the rectangular hole 34 in the part which stands face to face against the point light source as the prism deficit section in this example. By forming the hole 34 of this rectangle, effectiveness equivalent to the 3rd operation gestalt can be acquired.

[0030] The 3rd modification of the prism deficit section of the optical member 31 mentioned above is shown in drawing 9 (a) and (b). It is the example in which the concave hole 35 with which the center was narrow from the edge with the hole and became narrow as the prism deficit section in this example at the part which stands face to face against the point light source was formed. By forming this concave hole 35, effectiveness equivalent to the 3rd operation gestalt can be acquired.

[0031] Next, the 4th operation gestalt is explained. Drawing 10 shows the example which arranges the prism configuration part of the optical member shown in drawing 1 to a point light source [not a light guide plate but] side. Here, the arrow head to illustrate shows the travelling direction of each beam of light. Although a thing equivalent as effectiveness is obtained as a description of such an optical member 41 Only the beam of light 42 of the illumination light which carried out incidence to the prism crowning (heights or crevice) which stands face to face against the point light source and a transverse plane penetrates as it is, and carries out incidence from the perpendicular

direction (Z direction) of the plane of incidence of a light guide plate so that it may illustrate. Moreover, the beam of light which has a flare angle near the angle of refraction of a prism configuration with the beam of light which carried out outgoing radiation from the point light source 40 will be spread toward about Z directions, if incidence is carried out into a light guide plate. A beam of light 43 is irradiated so that it may go to an outside edge other than [most] this. The beam of light which goes straight on among the beams of light which carry out incidence by this is divided into about two, and it is served as if the one point light source became two pieces. The light which spread from the point light source and carried out outgoing radiation at the include angle of about zero angle is bent by refraction, and carries out incidence to a light guide plate. In this arrangement, there is almost no loss by the total reflection in prism, and there is effectiveness raised in the amount of illumination light to what is depended on the 1st operation gestalt.

[0032] The example of a configuration of the lighting system which formed the prism configuration part in the light guide plate is shown in drawing 11 as 5th operation gestalt, and it explains to it. This lighting system is the example in which the prism configuration part mentioned above in the plane-of-incidence 44a side of a light guide plate 44 was formed, between the three point light sources 4 and plane-of-incidence 44a, arranges the diffusion plate 8 and is constituted. The mark of a component part can be reduced by such configuration, and reduction-ization of cost can be attained. In addition, with this operation gestalt, although the diffusion plate 8 has been arranged to light guide plate 44 this side, it can also give a diffusion function instead of this by carrying out surface roughening of the front face of the prism configuration section of plane-of-incidence 44a. This becomes possible to reduce components mark further.

[0033] The example of a configuration of the lighting system concerning the 6th operation gestalt is shown in drawing 12 , and it explains to it. Here, drawing 12 (a) shows the configuration seen from the top, and drawing 12 (b) is drawing showing the configuration which looked at plane of incidence from the point light source side. The arrow head to illustrate shows the travelling direction of each beam of light.

[0034] This light guide plate 51 uses one of them as an incidence part, and the refraction parts 51a, 51b, and 51c which consist of three prism configurations are formed on both sides of parts for a flat part 52a and 52b between each. Moreover, the point light source 4 which consists of light emitting diode (LED 4a, 4b, and 4c) so that face to face may be stood against the mid gear of these refraction parts 51a, 51b, and 51c is arranged.

[0035] In such a configuration, the beam of light which carried out outgoing radiation near zero angle of divergence from the point light source 4 is spread, carrying out total reflection of the inside of a light guide plate in the direction almost equal to the angle of refraction of a prism configuration. The beam of light which, on the other hand, has the large flare angle which carried out outgoing radiation from the point light source 4 will be spread toward the direction of slant according to a Snell's law, if incidence is carried out to a part for said flat part. In this case, when observing from a direction vertical to light guide plate 51 front face which is the observation include angle used most as a display, the muscle-like dispersion pattern explained by the term of the trouble resulting from the beam-of-light group which progresses to a Z direction is not seen.

[0036] Therefore, the dispersion sources seen when all the directions of a beam of light that spread the inside of a light guide plate 51 are mostly observed from a transverse plane on a display by attaching an include angle not in a Z direction but in a Z-X flat surface can be lost. Though natural, it becomes possible by preparing a diffusion configuration in the incidence part of a light guide plate 51 simultaneously to acquire homogeneity-distribution.

[0037] The amount of [52a and 52b] flat part does not need to form the refraction parts 51a, 51b, and 51c among

the plane of incidence of a light guide plate 51 for the field which carries out incidence only of the beam of light which is not parallel from the point light sources 4a, 4b, and 4c to a Z direction.

[0038] Moreover, although drawing 13 established the non-refracted field by parts for a flat part 52a and 52b in the plane of incidence of the light guide plate 51 in the 6th operation gestalt mentioned above, it is the modification which prepared the non-refracted field by parts for the slit-like flat part 53a and 53b instead of this.

[0039] The example of a configuration of the lighting system concerning the 7th operation gestalt is shown in drawing 14 , and it explains to it. This operation gestalt forms in the plane-of-incidence [of an optical member], or plane-of-incidence side of a light guide plate the refraction part 61 of the Fresnel configuration which changes into an almost parallel beam of light the beam of light which was irradiated from the source of point luminescence, and which spread and had an angle. Width of face K of this Fresnel configuration is made equal to the pitch P of the light source as shown in drawing 1 (a). Moreover, since the height of the intensity distribution by the point light source remains, you may make it give a diffusion function in this configuration, by forming prism 61b for flat part part 61a of the center of the refraction part 61 which is in a direction about 0 times from the point light source, as shown in drawing 15 . By forming prism in the center of this Fresnel configuration, the parallel ray irradiated from near [where brightness is the highest] a point light source center can be reduced, and flattening of the optical intensity distribution can be carried out.

[0040] Next, the example of an installation configuration for fixing to a light guide plate the optical member mentioned above is shown in drawing 16 , and it explains to it. This example of an installation configuration is an example which acquires the ease of installation, and the effectiveness of positive positioning by forming the pin-like projections 62a and 62b in the outside of measuring area L1 at a light guide plate 63, and making the holes 65a and 65b for immobilization in two places of the ends of the optical member 64. Of course, it is also possible immobilization by the tape-like member and to prepare a lobe in a flat surface and to make easy immobilization with the sheet member of the circumference of the light source.

[0041] The modification of the example of an installation configuration for fixing to a light guide plate the optical member mentioned above is shown in drawing 17 , and it explains to it. the horseshoe-shaped case 71 for storing the point light source -- two holes 74a, 74b, 74c, and 74d for immobilization are made up and down, respectively. The heights 75a, 75b, 75c, and 75d which fit into these holes for immobilization are formed in the optical member 72. And the optical member 72 is inserted in a case 71, and it attaches in a light guide plate 73.

[0042] As explained above, according to the lighting system of each operation gestalt mentioned above, the scattered light (bright line) from the light guide plate front face generated according to the point light source is removable. Moreover, the illumination light of the same high brightness can be obtained, being able to arrange plurality on a straight line to light guide plate plane of incidence, being able to use as the line light source, and making a tooth space small compared with fluorescence tubing etc. by making large light emitting diode of the luminescence power per power consumption etc. into the point light source.

[0043]

[Effect of the Invention] As explained in full detail above, dispersion to the display direction of a point light source proper can be removed by according to this invention, changing a direction and optical intensity distribution, as the illumination light from the point light source is made refracted according to the incident angle to a light guide plate, and making it uniform just like the line light source, and the lighting system which raises display quality can be

offered.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is drawing showing the optical member concerning the 1st operation gestalt in the lighting system of this invention.

[Drawing 2] It is drawing showing the example of a configuration of the lighting system which mounted the optical member of the 1st operation gestalt in the light guide plate.

[Drawing 3] It is drawing showing an example of the optical intensity distribution by the optical member of the 1st operation gestalt.

[Drawing 4] It is drawing showing the example of a configuration of the lighting system concerning the 2nd operation gestalt.

[Drawing 5] It is drawing showing an example of the travelling direction of the beam of light in the optical member of the 2nd operation gestalt.

[Drawing 6] It is drawing showing the optical member concerning the 3rd operation gestalt in the lighting system of this invention.

[Drawing 7] It is drawing showing the 1st modification of the prism deficit section of the optical member concerning the 3rd operation gestalt.

[Drawing 8] It is drawing showing the 2nd modification of the prism deficit section of the optical member concerning the 3rd operation gestalt.

[Drawing 9] It is drawing showing the 3rd modification of the prism deficit section of the optical member concerning the 3rd operation gestalt.

[Drawing 10] It is drawing showing the optical member concerning the 4th operation gestalt in the lighting system of this invention.

[Drawing 11] It is drawing showing the example of a configuration of the lighting system which mounted the optical member of the 5th operation gestalt in the light guide plate.

[Drawing 12] It is drawing showing the example of a configuration of the lighting system which mounted the optical member of the 6th operation gestalt in the light guide plate.

[Drawing 13] It is drawing showing the modification of the light guide plate in the 6th operation gestalt.

[Drawing 14] It is drawing showing the optical member of the lighting system concerning the 7th operation gestalt.

[Drawing 15] It is drawing showing the modification of the light guide plate in the 7th operation gestalt.

[Drawing 16] It is drawing showing the example of an installation configuration for fixing the optical member of the lighting system of this invention to a light guide plate.

[Drawing 17] It is drawing showing the modification of the example of an installation configuration for fixing the optical member of the lighting system of this invention to a light guide plate.

[Drawing 18] It is drawing for explaining the conventional lighting system.

[Description of Notations]

1 -- Optical member

1a -- Plane of incidence

1b -- Outgoing radiation side

2 3 -- Point light source

4, 4a, 4b, 4c -- Light emitting diode (LED)

5 -- Case

6 -- Light guide plate

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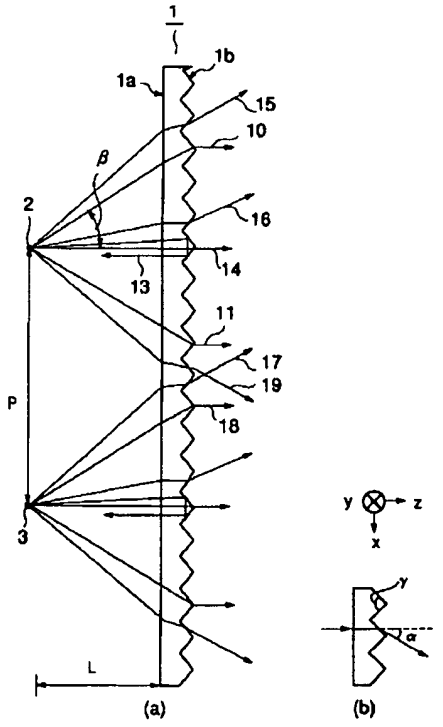
(54)【発明の名称】　照明装置

(57)【要約】
【課題】従来の反射型液晶装置に用いられる照明装置は、照明光を液晶表面まで導く導光板に反射用突起が設けられ、この突起による散乱光の反射で連続的な輝線が画面上に現れ、視認性の面で問題となった。
【解決手段】本発明は、点光源から拡がった光を入射角に応じて屈折させて導光板への入射角を変換して出射するマイクロプリズムが形成された光学部材１を導光板の前方に配置することにより、種々の方向に光線を導光板へ入射させて散乱光による輝線を防止して液晶表示部を均一的に照明する照明装置である。



【特許請求の範囲】
【請求項１】　光を照射する少なくとも１つの点光源と、
前記点光源からの照明光を被照明体側に反射する反射部を有する導光板と、を備える照明装置において、
前記点光源からの照明光を入射角に応じて屈折させることにより、前記照明光の出射方向及び光強度分布を変換して、前記導光板へ出射する光学部材を具備し、
前記光学部材が前記点光源と前記導光板との間に配置されることを特徴とする照明装置。
【請求項２】　前記光学部材は、光入射面若しくは光出射面のいずれか一方に光線を屈折させるように機能するマイクロプリズムが形成されることを特徴とする請求項１に記載の照明装置。
【請求項３】　前記照明装置において、
前記マイクロプリズムの屈折角をα、該マイクロプリズムが形成された光学部材と点光源との距離をＬ、複数の前記点光源間のピッチをＰ、前記点光源の有効拡がり半角をβとした時、
α＝β、　Ｐ／２＝Ｌ・ｔａｎβ
となるように前記マイクロプリズムの屈折角を設定することを特徴とする請求項２に記載の照明装置。
【請求項４】　前記照明装置において、
前記点光源と前記光学部材との間に、光を拡散させるための拡散板を介在させることを特徴とする請求項１に記載の照明装置。
【請求項５】　前記照明装置において、
前記光学部材の光入射面若しくは光出射面のいずれか一方の表面に微小な凹凸を設けて光線を拡散させる機能を具備することを特徴とする請求項２に記載の照明装置。
【請求項６】　前記照明装置において、
前記光学部材に、点光源の配置及び強度分布に応じてプリズム欠損部を設けることを特徴とする請求項１に記載の照明装置。
【請求項７】　光を照射する点光源と、
前記点光源からの照明光を被照明体側に反射する反射部を有する導光板と、を具備し、
前記導光板の光入射面に、前記点光源からの照明光を入射角に応じて屈折させることにより、前記照明光の進行方向及び光強度分布を変換させるマイクロプリズムが形成されることを特徴とする照明装置。
【請求項８】　前記照明装置において、
前記導光板の光入射面に形成されたマイクロプリズムの表面に微小な凹凸を設けて光線を拡散させる機能を具備することを特徴とする請求項７に記載の照明装置。
【請求項９】　光を照射する点光源と、
前記点光源からの照明光を被照明体側に反射する反射部を有する導光板と、を備える照明装置において、
前記導光板の光入射面が前記点光源からの照明光を入射角に応じて屈折させることにより、前記照明光の進行方向及び光強度分布を変換させるフレネル形状に形成されることを特徴とする照明装置。
【請求項１０】　前記照明装置において、
前記フレネル形状が形成された光入射面で前記点光源から最も強い輝度の光線が入射する部分にプリズムを形成することを特徴とする請求項９に記載の照明装置。
【請求項１１】　前記照明装置において、
前記導光板の光入射面における有効面以外の領域に設けられたガイド部と、
前記光学部材の光出射面における有効面以外の領域に前記ガイド部に嵌合する固定穴とを具備し、
前記ガイド部に固定穴が嵌め込まれて前記導光板が所定位置に固定されることを特徴とする請求項１に記載の照明装置。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、反射型液晶表示装置に用いられる照明装置に関する。
【０００２】
【従来の技術】一般に液晶表示装置は、周囲が暗くとも使用することができるように照明装置が備えられている。大別すると、透過型液晶表示装置の裏側から照明するバックライト型照明装置と、反射型液晶表示装置の表側から照明するフロントライト型照明装置がある。小型携帯機器には、小型軽量化や低消費電力が求められているため、表示には反射型液晶表示装置が多く利用され、必要なときに照明することができるフロントライト型照明装置が搭載されている。
【０００３】従来のフロントライト型照明装置においては、液晶表示画面の前方に導光板を設けて、横方向から導光板内に照明光を入射して、画面全体を明るくしている。従って、画面全体を均一的な明るさとすることが望まれており、蛍光灯等の線光源を画面側面に配置して照明光を入射していた。
【０００４】しかし、蛍光灯を用いた場合、照明装置の厚みが増しまうという問題があり、発光ダイオード（ＬＥＤ）等の点光源を用いることが考えられている。この点光源を用いた場合には、小型化や低消費電力化が実現できる反面、点光源であるため表示画面における光強度の差（輝度ムラ）が光源近傍とその周辺とで大きくなるという問題がある。そのため、点光源を複数配置したり、点光源と導光板の間に拡散板を配置して輝度のピークを緩和させたりと種々の試みがなされている。
【０００５】
【発明が解決しようとする課題】前述した点光源による照明装置の場合に、点光源を拡散板で拡散する構成においては、導光板へ入射する光線の拡がり角だけが大きくなるだけであり、光線の方向を変換しているものではなく、その発光源自体は一点からの発光であることには変わりがない。従って、効果としては、画面全体的な輝度

ムラがやや緩和される程度である。

【０００６】また導光板には、液晶表示部側へ反射するための反射面を持つリブ状突起が設けられ、明るさが均一になるように工夫されている。しかし、これを実施すると、突起部分で反射による連続的な輝線（散乱光）が発生し、画面上に直線状の筋光が現れ、視認性の面で問題となった。この問題に対して前述した拡散板を用いた場合、筋光がボケる程度であって、視認性の面で解決しているとはいえない。

【０００７】これに対して、例えば特開平１０－１８６３６号公報において、図１８に示すような導光板８１の反射面に多数の円柱状突起８２を形成して、点光源８３からの入射光を拡散させて、連続的な輝線の発生を抑制して、均一な照明を実現する照明装置が提案されている。この技術は、直線状の筋光に見える輝線（散乱光）の発生を抑制する点で効果を有しているが、この技術も拡散板と同様に、表示画面の多数箇所で照明光を拡散して輝度ムラが線状になることを防止しているだけであり、入射する光線の方向を変換する機能がないため、画面全体から見れば、点光源に近いほど輝度が高く、遠くの周辺ほど暗くなる環状の広がりを見せて、発光源自体は点であることには変わりがない。

【０００８】そこで本発明は、点光源からの照明光を導光板への入射角に応じて屈折させるようにして、方向及び光強度分布を変換して線光源並に一様にすることで点光源固有の表示方向への散乱を除去し、表示品質を向上させる照明装置を提供することを目的とする。

【０００９】

【課題を解決するための手段】本発明は上記目的を達成するために、光を照射する少なくとも１つの点光源と、前記点光源からの照明光を被照明体側に反射する反射部を有する導光板とを備える照明装置において、前記点光源からの照明光を入射角に応じて屈折させることにより、前記照明光の出射方向及び光強度分布を変換して、前記導光板へ照射する光学部材を具備し、前記光学部材が前記点光源と前記導光板との間に配置される照明装置を提供する。

【００１０】前記光学部材は、光入射面若しくは光出射面のいずれか一方に光線を屈折させるように機能するマイクロプリズムが形成される。また、前記照明装置において、前記マイクロプリズムの屈折角をα、該マイクロプリズムが形成された光学部材と点光源との距離をＬ、複数の前記点光源間のピッチをＰ、前記点光源の有効拡がり半角をβとした時、$\alpha=\beta$、　$P/2=L\cdot\tan\beta$となるように前記マイクロプリズムの屈折角を設定する。

【００１１】また、光を照射する点光源と、前記点光源からの照明光を被照明体側に反射する反射部を有する導光板とを備える照明装置において、前記導光板の光入射面に、前記点光源からの照明光を入射角に応じて屈折させることにより、前記照明光の進行方向及び光強度分布を変換させるマイクロプリズムが形成される照明装置を提供する。

【００１２】以上のような構成の照明装置において、一方面にマイクロプリズムが形成された光学部材は点光源が照射した照明光を入射角に応じて屈折させて入射方向を変換して出射しており、この光学部材を導光板の前方に配置することにより、種々の方向に光線を導光板へ入射させて散乱光による直線状の筋光に見える輝線（以下、輝線と称する）を防止して液晶表示部を均一的に照明する。

【００１３】

【発明の実施の形態】以下、図面を参照して本発明の実施形態について詳細に説明する。本発明は、点光源から拡がった光を入射角に応じて屈折させて導光板への入射角を変換するプリズム形状（マイクロプリズム）の光学部材を搭載する照明装置であり、導光板の光線入射面の前方に配置して、光源の強度分布をよりフラットにする構成である。図１には、本発明の照明装置における第１の実施形態に係る光学部材を示し概念的な説明を行う。この例では、説明の簡易化のために２つの点光源を備える照明装置を一例にして説明する。図中の矢印は、それぞれの光線の進行方向を示している。

【００１４】図１（ａ）に示す光学部材１は、上方向から見た状態を示しており、平坦な入射面１ａと後述する複数の三角柱が連続するプリズム形状が形成された出射面１ｂとで構成され、透明な樹脂やガラス等により形成されている。この図では、矢印は照明光となる光線の経路を示しており、プリズム頂角γは、９０度が想定されているが、後述するように設計に従って種々変更される。

【００１５】また、光学部材１の入射面１ａ側には、距離Ｌを離れてピッチＰの間隔で２つの点光源２、３が配置されている。図１（ｂ）に示すように、この光学部材１の屈折角αは、垂直に入射した光線と出射した光線との相対角度で表される。

【００１６】この光学部材１における照明光（光線）の進行方向と光強度分布の変更について説明する。例えば、点光源２から照射された光線の有効広がり半角をβとし、その方向の光線１０とすると、その光線１０は光学部材１の入射面１ａと出射面１ｂとでそれぞれ屈折され、ほぼＺ方向に変換されて出射されるように光学部材１の屈折角αを設定する。このＺ方向は、図示しない導光板の入射面に対して垂直な方向であるものとする。つまり、$\alpha=\beta$となるようプリズム頂角γを設定する。光線１１も光線１０と同様である。一方、光源２からほぼＺ方向に出射した光線のうち、光線１３は出射面１ｂ側で全反射した後、再び光源２側へ戻るため、導光板へは入射されない。しかし、プリズム頂点付近には、製作精度できまる微視的に一部平坦な面も有しており、その面

に入射した光線１４は全反射せず、透過して導光板へと進む。

【００１７】従って、導光板側から見ると同一のＺ方向へ進む光線１０、１１、１４に渡る幅を持った線状光線として出射しているかのように振舞うことになる。同様に、照射方向が異なるが、光線１５、１６及び隣の点光源３から照射された光線１７も光線１５から光線１７に渡る幅を持った照明光として出射される。

【００１８】また、点光源２、３の間隔Ｐは、有効広がり半角をβとした場合、光線１１と光線１８とがほぼ重なるように決定すればよく、

Ｐ／２＝Ｌ・tanβ　　…（１）

となるようにすればよい。光源の有効広がり半角βをさらに広く取る場合は、例えば光線１７、１９が光学部材１の出射面でほぼ重なるように上記式（１）を用いて設定すればよい。尚、光学部材１は、屈折率分布を持たせて、プリズムによる屈折効果と等価な効果を得ることもできる。

【００１９】図２に本実施形態の光学部材を導光板に実装した照明装置の構成例を示して説明する。ここで、図２（ａ）は上から見た構成を示し、図２（ｂ）は図２（ａ）の線分Ａ－Ａにおける断面構成を示す。また図中の矢印は、それぞれの光線の進行方向を示している。この照明装置は、点光源４となる例えば、３個の発光ダイオード（ＬＥＤ）４ａ，４ｂ，４ｃと、これらの点光源４を収納して直線上に配置し、それらの点光源４前方に前述した光学部材１を配置するコ字型の筐体５とで構成される。これらの点光源４の個数は、要求される輝度値と消費電力を考慮した任意の個数であり、電気的接続を介して図示しない駆動回路により駆動されて発光する。この筐体５は、点光源４の拡がりを持った照明光を効率よく導光板６へ入射させるための反射板としても機能し、その内部表面上にアルミ又は白いテフロン（登録商標）、硫酸バリウム、酸化マグネシウムなどの粉末等からなる光反射率部材が設けられている。また、これらの光反射率部材は、シート状に形成して筐体５内壁へ取り付けてもよい。

【００２０】導光板６の材料は、例えばアクリル、ポリカーボネート若しくは、ポリオレフィン系の材料からなり、屈折率１．５前後の値を有している。導光板６内に入射された光線のうち臨界角以上の入射角を持つ光線は、平坦部６ａ及びその対向する面６ｂを全反射しながら、導光板内を伝搬する。前記臨界角は、材料の屈折率からｓｉｎ（１／１．５）で求められ、約４２度となる。導光板内を伝搬する臨界角以上の入射角を持った光線は、その一部が微小な反射面６ｃで液晶表示部７へ向けて反射され、液晶の反射率に従って再度観察者側Ｂへ反射することにより、液晶で表示された画像が観察される。

【００２１】以上のことから、本実施形態の照明装置は一方面にマイクロプリズムが形成された光学部材を用いることにより、点光源であるＬＥＤが照射した照明光を入射角に応じて屈折させて、照明光の導光板への入射方向を変換して、散乱光による輝線を防止して液晶表示部を均一的に照明することができる。

【００２２】次に第２の実施形態に係る照明装置について説明する。図３には、前述した第１の実施形態の光学部材１による光強度分布の一例を示す。図示するように、点光源であるＬＥＤ４の発光時の光強度分布は、発光源の正面が一番高いピークとなり、周辺に行くにしたがって、光強度が下がっていく特徴がある。一方、光学部材１を透過した照明光の光強度分布（実線ｍ）は、ＬＥＤ４の光強度分布に比べると、発光側の正面から少し周囲側に離れた両脇部分に２つのピークができ、正面が強度が弱くなった分布になっている。これは、図１に示したように点光源の正面から照射された照明光には、光学部材１のプリズムで反射されて戻ってくる光線１３があるため、周囲の角度を持った光線よりも透過される量が少なくなるために発生する。

【００２３】そこで本実施形態では、前述した第１の実施形態における点光源４と光学部材１との間に拡散板８を配置して、光学部位１を透過した光強度分布の平坦化を図っている。ここで、図４（ａ）は上から見た構成を示し、図４（ｂ）は図４（ａ）の線分Ｃ－Ｃにおける断面構成を示す。この拡散板８を照明光を透過させることにより、図５に示すように、ほぼ同一の場所からさまざまな出射角の光線が光学部材１へ入射することになり、導光板６側からみると光線２０、２１のように様々な角度の方向に出射されるため、各点から様々な方向に拡散して、図３の点線ｎで示す照明光の光強度の様になり、線照明や面照明により近づくことができる。

【００２４】次に第３の実施形態について説明する。

【００２５】前述した実施形態では、拡散板を用いて、光強度分布の平坦化を図ったが、本実施形態は、光学部材を改良して、光強度分布の平坦化を実現する例である。本実施形態の光学部材は、点光源と対峙する正面部分の照明光の透過を増加させるプリズム欠損部を設けている。

【００２６】図６（ａ），（ｂ）に示すように、光学部材３１に点光源と対峙する位置に、強度分布に応じて４つの孔からなるプリズム欠損部３２を設けている。勿論、４つの孔は、一例であって、１つから複数の孔を設けることもでき、その配置も光強度分布を平坦化にするように配置される。前述した光学部材の屈折角α、光学部材と点光源との距離Ｌ、複数の点光源間のピッチＰ、点光源の有効拡がり半角βのそれぞれ組み合わせにより、必ずしも線状光源と同等にならない場合は、このプリズム欠損部３２を設けて、点光源の強度が通常最も強い拡がり角０度から２０度近傍の光線による強度ムラを抑え、よりフラットな線状光源に変換することが可能と

なる。

【００２７】本実施形態では、４つの孔からなるプリズム欠損部３２を設けているが、この形状は任意であり、プリズム状形状の面積を場所に変化させられれば機能を果たすことができる。

【００２８】図７（ａ），（ｂ）には、前述した光学部材３１のプリズム欠損部の第１の変形例を示す。この例では、プリズム欠損部として、点光源と対峙する出射面側に形成されたプリズムを無くし、平坦な領域３３を設けた例である。この平坦な領域３３を設けることにより、第３の実施形態と同等な効果を得ることができる。

【００２９】図８（ａ），（ｂ）には、前述した光学部材３１のプリズム欠損部の第２の変形例を示す。この例では、プリズム欠損部として、点光源と対峙する部分に長方形の孔３４を形成した例である。この長方形の孔３４を形成することにより、第３の実施形態と同等な効果を得ることができる。

【００３０】図９（ａ），（ｂ）には、前述した光学部材３１のプリズム欠損部の第３の変形例を示す。この例では、プリズム欠損部として、点光源と対峙する部分に中央が端部よりもくびれて狭くなった凹型の孔３５を形成した例である。この凹型の孔３５を形成することにより、第３の実施形態と同等な効果を得ることができる。

【００３１】次に、第４の実施形態について説明する。図１０は、図１に示した光学部材のプリズム形状部分を導光板側ではなく、点光源側に配置する例を示している。ここで、図示する矢印は、それぞれの光線の進行方向を示している。このような光学部材４１の特徴としては、効果としては同等のものが得られるが、図示するように、点光源と正面に対峙するプリズム頂部（凸部または凹部）に入射した照明光の光線４２のみがそのまま透過して導光板の入射面の垂直方向（Ｚ方向）から入射し、また点光源４０から出射した光線でプリズム形状の屈折角に近い拡がり角を持つ光線は、導光板内に入射すると、ほぼＺ方向へ向かって伝搬する。これ以外のほとんどが外側端に向かうように光線４３が照射される。これにより入射する光線のうち、直進する光線はほぼ２つに分かれ、１つの点光源があたかも、２個になったかのように振る舞う。点光源から拡がり角０度近傍の角度で出射した光は、屈折により曲げられて導光板へ入射する。この配置では、プリズム内の全反射による損失がほとんどなく、第１の実施形態によるものに対して照明光量を向上させられる効果がある。

【００３２】図１１には、第５の実施形態として、プリズム形状部分を導光板に形成した照明装置の構成例を示し説明する。この照明装置は、導光板４４の入射面４４ａ側に前述したプリズム形状部分を形成した例であり、３個の点光源４と入射面４４ａとの間に拡散板８を配置して構成される。このような構成により構成部品の点数を削減することができ、コストの低減化を図れる。尚、本実施形態では、拡散板８は導光板４４手前に配置したが、これに代わって、入射面４４ａのプリズム形状部の表面を粗面化することにより、拡散機能を持たせることもできる。これにより、部品点数をさらに減らすことが可能となる。

【００３３】図１２には、第６の実施形態に係る照明装置の構成例を示し説明する。ここで、図１２（ａ）は上から見た構成を示し、図１２（ｂ）は、点光源側から入射面を見た構成を示す図である。図示する矢印は、それぞれの光線の進行方向を示している。

【００３４】この導光板５１は、その一辺を入射部分とし、３つのプリズム形状からなる屈折部分５１ａ，５１ｂ，５１ｃが、それぞれの間に平坦部分５２ａ，５２ｂを挟んで形成される。また、これらの屈折部分５１ａ，５１ｂ，５１ｃの中央位置に対峙するように発光ダイオード（ＬＥＤ４ａ，４ｂ，４ｃ）からなる点光源４が配置される。

【００３５】このような構成において、点光源４から広がり角０度付近で出射した光線は、プリズム形状の屈折角にほぼ等しい方向へ導光板内を全反射しながら伝搬される。一方、点光源４から出射した大きい拡がり角を持つ光線は、前記平坦部分に入射すると、スネルの法則に従い斜め方向へ向かって伝搬する。この場合、ディスプレイとして、最も使う観察角度である導光板５１表面に垂直な方向から観察する場合、Ｚ方向へ進む光線群に起因する問題点の項で説明した筋状の散乱パターンが見られない。

【００３６】従って、導光板５１内を伝搬する光線方向をすべてＺ方向ではなく、Ｚ－Ｘ平面内で角度を付けることにより、ディスプレイにほぼ正面から観察した場合に見られる散乱筋を無くすことができる。当然ながら、導光板５１の入射部分に拡散形状を同時に設けることにより、より均一的な分布を得ることが可能となる。

【００３７】導光板５１の入射面のうち、平坦部分５２ａ，５２ｂは、点光源４ａ，４ｂ，４ｃからＺ方向に対して平行ではない光線しか入射しない領域のため、屈折部分５１ａ，５１ｂ，５１ｃを形成する必要はない。

【００３８】また、図１３は、前述した第６の実施形態における導光板５１の入射面に平坦部分５２ａ，５２ｂによる非屈折領域を設けたが、これに代わって、スリット状の平坦部分５３ａ，５３ｂによる非屈折領域を設けた変形例である。

【００３９】図１４には、第７の実施形態に係る照明装置の構成例を示し説明する。本実施形態は、光学部材の入射面側若しくは導光板の入射面側に、点発光源から照射された拡がり角を持った光線をほぼ平行な光線に変換するフレネル形状の屈折部分６１を形成する。このフレネル形状の幅Ｋは、図１（ａ）に示したように光源のピッチＰと等しくする。また、この形状では、点光源による強度分布の高低が残っているため、図１５に示すよう

に、点光源からほぼ０度方向にある屈折部分６１の中央の平坦部分６１ａをプリズム６１ｂを形成することにより、拡散機能を持たせるようにしてもよい。このフレネル形状の中央にプリズムを形成することにより、最も輝度の高い点光源中央付近から照射される平行光線を減らして、光強度分布を平坦化することができる。

【００４０】次に図１６には、前述した光学部材を導光板に固定するための取り付け構成例を示して説明する。この取り付け構成例は、有効面Ｌ１の外側にピン状の突起６２ａ，６２ｂを導光板６３に設け、光学部材６４の両端の２箇所に固定用穴６５ａ，６５ｂを開けることにより、取り付けの容易さと確実な位置決めの効果を得る例である。勿論、テープ状の部材での固定や、平面内に突出部を設けて光源回りのシート部材との固定を容易にすることも可能である。

【００４１】図１７には、前述した光学部材を導光板に固定するための取り付け構成例の変形例を示して説明する。点光源を格納するためのコ字型の筐体７１の上下にそれぞれ２個の固定用穴７４ａ，７４ｂ、７４ｃ，７４ｄを開ける。これらの固定用穴に嵌合するような突起部７５ａ，７５ｂ，７５ｃ，７５ｄを光学部材７２に形成する。そして、筐体７１に光学部材７２を嵌め込み、導光板７３に取り付ける。

【００４２】以上説明したように、前述した各実施形態の照明装置によれば、点光源により発生する導光板表面からの散乱光（輝線）を除去することができる。また消費電力あたりの発光パワーの大きい発光ダイオード等を点光源として導光板入射面に対して複数を直線上に配置して線光源として利用することができ、蛍光管等に比べてスペースを小さくしつつ、同様な高輝度の照明光を得ることができる。

【００４３】

【発明の効果】以上詳述したように本発明によれば、点光源からの照明光を導光板への入射角に応じて屈折させるようにして、方向及び光強度分布を変換して線光源並に一様にすることで点光源固有の表示方向への散乱を除去し、表示品質を向上させる照明装置を提供することができる。

【図面の簡単な説明】

【図１】本発明の照明装置における第１の実施形態に係る光学部材を示す図である。

【図２】第１の実施形態の光学部材を導光板に実装した照明装置の構成例を示す図である。

【図３】第１の実施形態の光学部材による光強度分布の一例を示す図である。

【図４】第２の実施形態に係る照明装置の構成例を示す図である。

【図５】第２の実施形態の光学部材における光線の進行方向の一例を示す図である。

【図６】本発明の照明装置における第３の実施形態に係る光学部材を示す図である。

【図７】第３の実施形態に係る光学部材のプリズム欠損部の第１の変形例を示す図である。

【図８】第３の実施形態に係る光学部材のプリズム欠損部の第２の変形例を示す図である。

【図９】第３の実施形態に係る光学部材のプリズム欠損部の第３の変形例を示す図である。

【図１０】本発明の照明装置における第４の実施形態に係る光学部材を示す図である。

【図１１】第５の実施形態の光学部材を導光板に実装した照明装置の構成例を示す図である。

【図１２】第６の実施形態の光学部材を導光板に実装した照明装置の構成例を示す図である。

【図１３】第６の実施形態における導光板の変形例を示す図である。

【図１４】第７の実施形態に係る照明装置の光学部材を示す図である。

【図１５】第７の実施形態における導光板の変形例を示す図である。

【図１６】本発明の照明装置の光学部材を導光板に固定するための取り付け構成例を示す図である。

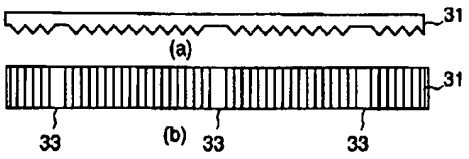
【図１７】本発明の照明装置の光学部材を導光板に固定するための取り付け構成例の変形例を示す図である。

【図１８】従来の照明装置について説明するための図である。

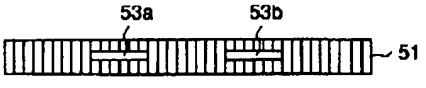
【符号の説明】

１…光学部材
１ａ…入射面
１ｂ…出射面
２，３…点光源
４，４ａ，４ｂ，４ｃ…発光ダイオード（ＬＥＤ）
５…筐体
６…導光板

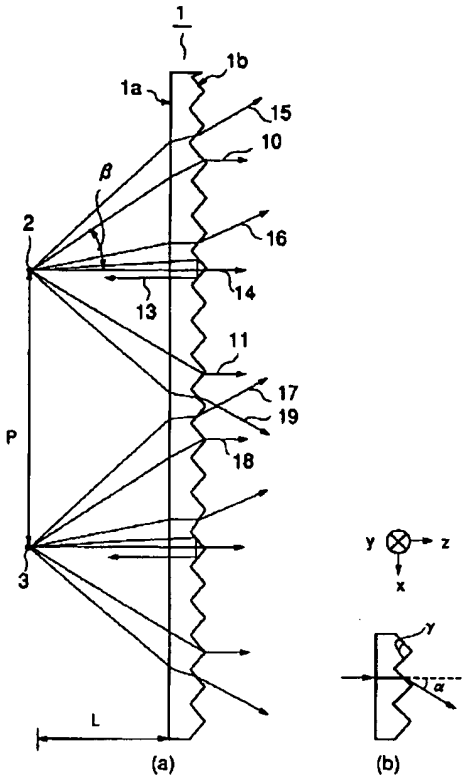
【図７】



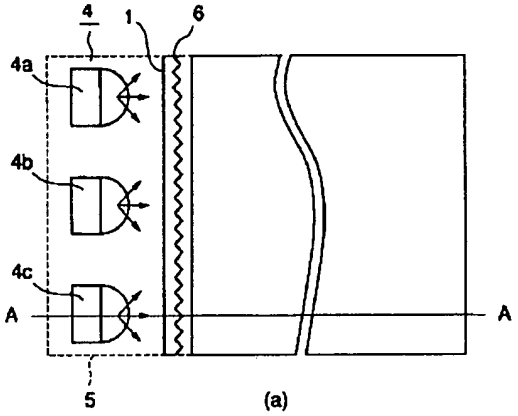
【図１３】



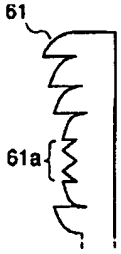
【図１】

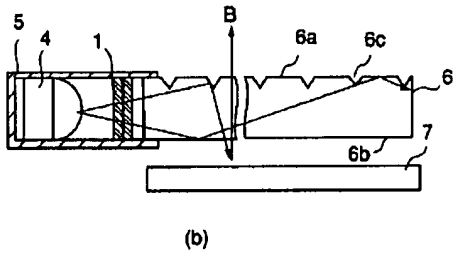


【図２】



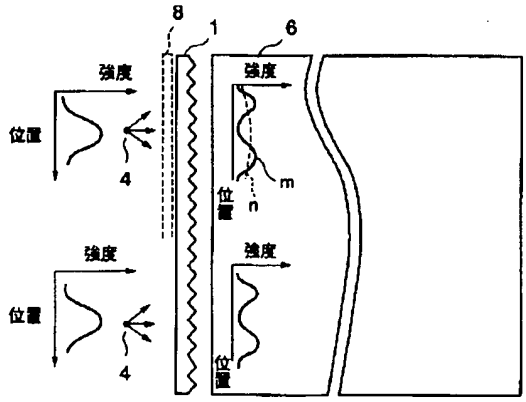
【図１５】

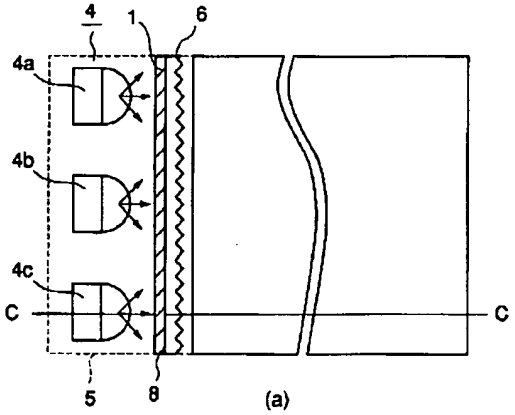




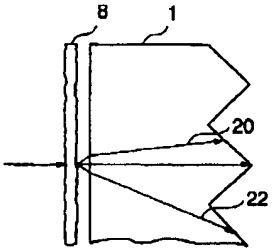
【図４】

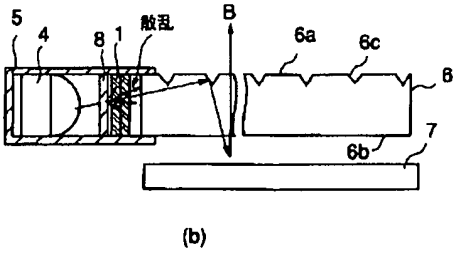
【図３】





【図５】





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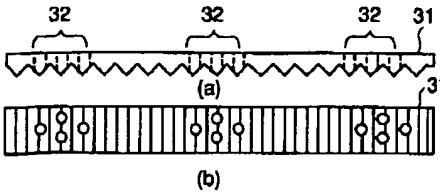

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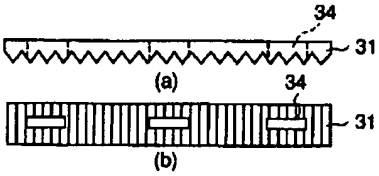

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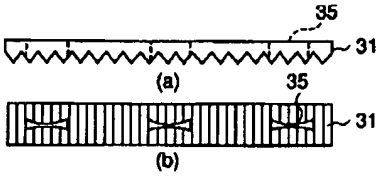

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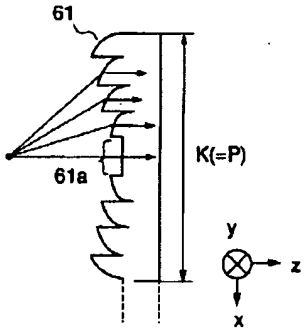

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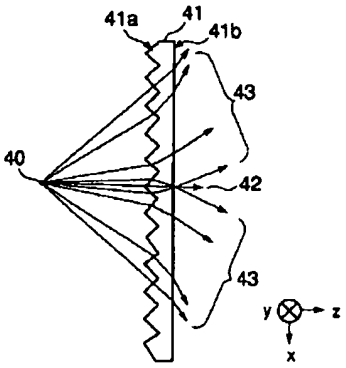

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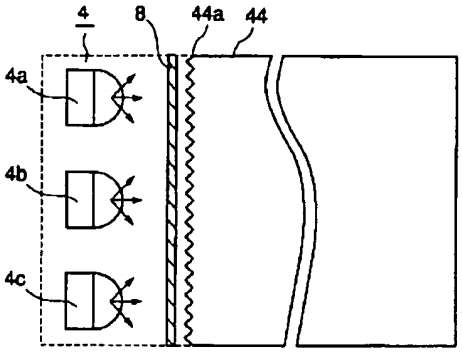

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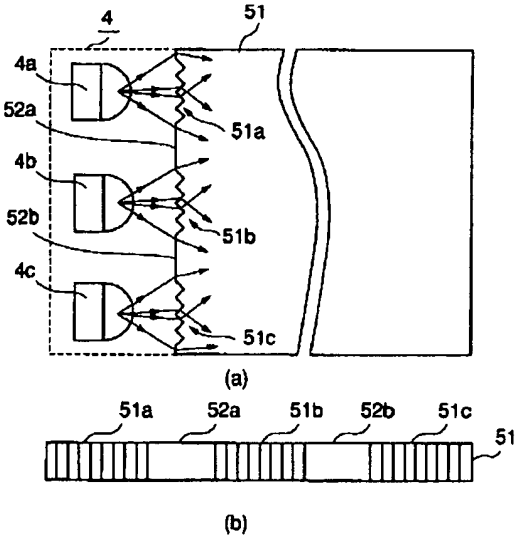

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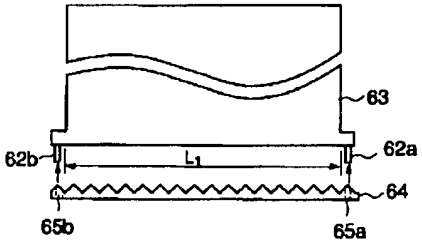

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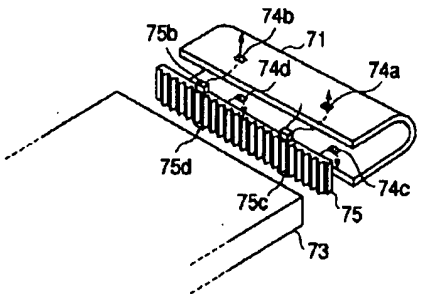

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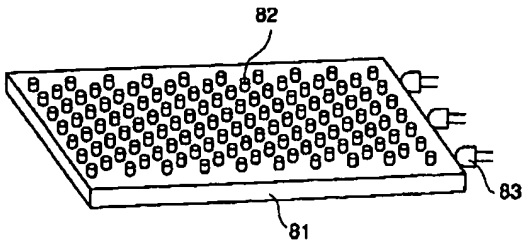

フロントページの続き

(51)Int.Cl.[7]	識別記号	Ｆ Ｉ		ﾃｰﾏｺｰﾄﾞ(参考)
Ｇ０９Ｆ 9/00	３３６	Ｇ０９Ｆ 9/00	３３６Ｂ	
// Ｆ２１Ｙ 101:02		Ｆ２１Ｙ 101:02		